Roentgen Examination of Soft Tissues of the Pelvis

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■ *With meticulous preparation of the patient and with careful technique, the soft tissues of the pelvis are identifiable in most cases. Search should be made for the traces of abnormal pelvic structures on plain-film studies. Once the normal is recognized, any variations are easily identified. The fundamental differences between various radiologic densities —air, fat, fluid, muscle, calcium, bone and metal—should be observed. Special procedures can be used to enhance the contrasts after adequate evaluation of the simplest and, on many occasions, the invaluable, plain-film study of the soft tissues of the pelvis.*

NORMAL PELVIC STRUCTURES are plainly visible in most roentgenograms of good technical quality when the urinary bladder has been emptied immediately before the x-ray exposure. Roentgenograms of the pelvis obtained in the supine and lateral positions provide a baseline examination of the soft tissues. When indicated, erect, decubitus and contrast studies provide additional valuable diagnostic films.

Normal Pelvic Anatomy[1]

Ligaments. The sacrospinous and sacrotuberous ligaments join the sacrum and ischium. The sacrospinous ligament is thin and triangular and is attached to the spine of the ischium. It continues medially to the lateral margin of the sacrum and coccyx in front of the sacrotuberous ligament. The fibers of the two ligaments are intermingled as the sacrotuberous ligament proceeds from the lower and back part of the pelvis to the point of insertion. The site of this insertion is in the inner margin of the ischial tuberosity along the inner margin of the ramus. The latter is flat, triangular in form at each end, and narrow in the middle. The greater sciatic foramen is bordered by the sacrotuberous ligament behind and the sacrospinous ligament below. The sacrotuberous ligament behind and the sacrospinous ligament above, confine the lesser sciatic foramen. These ligaments, when bordered by pelvic fat, are visible on roentgenograms as symmetrical densities.

Muscles. Two main muscle groups are identified, the true pelvic muscles and those of the legs. The true pelvic musculature that forms the pelvic diaphragm are the levator ani and the coccygeus. The obturator internus and the piriformis are muscles of the lower extremities. The piriformis leaves the pelvis by means of the greater sciatic foramen and

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the tendon of the obturator internus leaves by the lesser sciatic foramen. These muscle groups are seen in roentgenograms when outlined by pelvic fat.

Urinary Bladder. In the postvoiding state, soft-tissue density of the bladder is usually separated from the surrounding soft-tissues of the pelvis by adipose (relatively radiolucent) tissue. Otherwise, the shadows of the distended bladder preclude evaluation of other soft-tissue densities.

Miscellaneous. In females, the uterine shadow, when present, is usually definable, as are, on occasion, the adnexal structures. The rectal ampulla is usually empty of either air or fecal matter, whereas the rectosigmoid and sigmoid colon are usually a mottled soft-tissue density and may be misinterpreted as a significant soft-tissue mass, usually in the left adnexal area.

When these normal pelvic structures are seen, particularly those of the bladder in the postvoiding state, any other density of whatever nature usually constitutes a pathologic entity. Plain-film studies constitute a necessary prerequisite to any special procedure, such as contrast examination.

Densities of Pathologic Nature

Air. Occasionally air may be observed within the rectum or rectosigmoid, especially when cleansing enemas have been administered. Occasionally this air will delineate intrinsic colonic lesions. Air bubbles have been observed within colonic diverticula on plain-film study. They have also been seen within pelvic inflammatory masses and within the vaginal or uterine wall, or in both. When seen within the bladder wall and lumen in cystitis emphysematosus (Figure 3), underlying diabetes mellitus with a chronic refractory urinary infection is present in

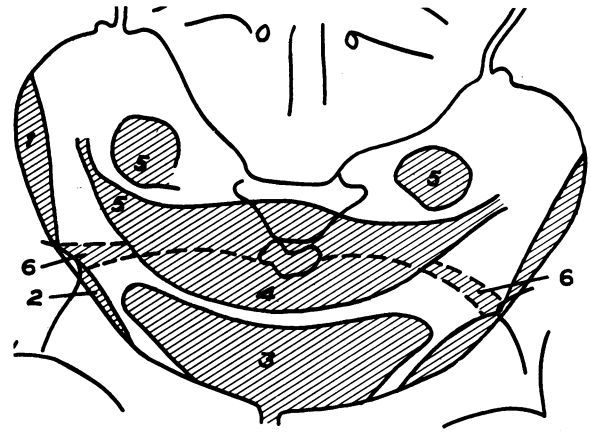

Figure 1.*—Normal anatomic positions as observed roentgenographically. (1) Obturator internus, (2) levator ani, (3) bladder, (4) uterus, (5) adnexa, (6) sacrospinous ligament.

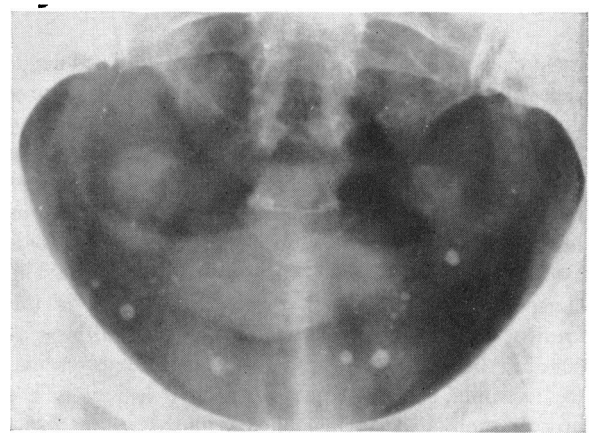

Figure 2.*—Plain film showing normal soft-tissue pelvic structure in a female.

*Figures 1, 2 and 7 appear in Noonan, C. D.: Plain-film diagnosis of acute gynecologic disorders and obstetric complications, 2:167-181, April, 1964. Courtesy, Radiologic Clinics of North America.

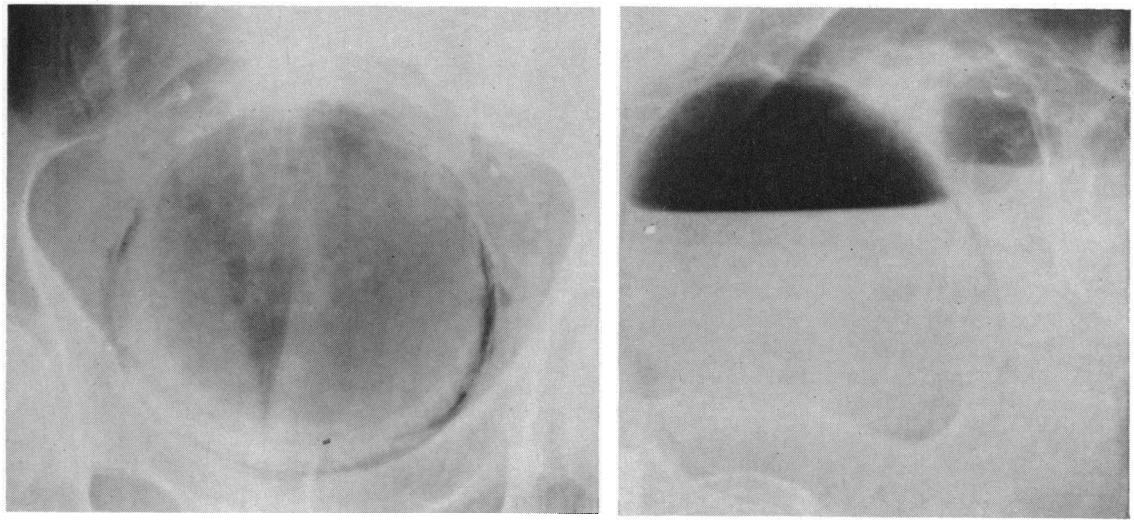

Figure 3.—Film showing cystitis emphysematosus. Left lateral decubitus view shows elevation of air-fluid level.

Figure 4.—Film showing ovarian teratoma.

most cases. Common organisms are *E. coli* and aero-aerogens. Glycosuria with fermentation that produces gas may lead to a false low blood sugar and be followed by a cycle of poor control, glycosuria and further infection. Otherwise, pneumaturia *per se* may indicate an intestinal fistula or previous instrumentation. The colonic wall in pneumatosis cystoides intestinalis contains these air bubbles. The cause of pneumatosis cystoides intestinalis is unknown. It has been observed in such conditions as chronic lung disease associated with emphysema, for example, scleroderma; obstructive lesions of the bowel, such as pyloric stenosis in the infant; secondary to surgical instrumentation, for example, sigmoidoscopy with or without biopsy; and Whipple's disease. It may be the cause of pneumoperitoneum.

Fat. Compared with pelvic muscle mass and the usual fluid-filled or solid structures, densities of pelvic fat are relatively radiolucent. Ovarian teratoma is the soft-tissue mass of the pelvis commonly clearly delineated by fat and abortive tooth formation (Figure 4). Usually, the areolar, fatty, soft-tissue pelvic planes are obliterated when inflammatory disease and extreme amounts of abdominal fluid are present.

Fluid or Mass, or Both. Abdominal fluid will resemble a pelvic mass in roentgenograms obtained in the supine position and characteristically will change or disappear with changes in position at the time of roentgenographic exposure. Characteristically, abdominal fluid gravitates into the pelvis, displacing any air-containing bowel from the pelvis. In the abdomen, the bowel is separated from the peritoneal fat lines, which are in continuity with the pelvic fascial fat planes. Small amounts of fluid easily escape detection and extreme amounts of peritoneal fluid usually will obliterate the fatty pelvic planes. The contour and position of either cystic or solid pelvic masses remain unchanged unless the tumors are attached by a long pedicle, or are of a fatty nature. They are identifiable by displacement of adjoining air-fluid structures or fluid-filled or solid viscera. Since, in the female pelvis, masses may be associated with abdominal fluid, evidence of both mass and fluid should be sought. Phlebolith densities that have become displaced after earlier studies of the pelvic tissues indicate that a pelvic mass has appeared in the

Figure 5.—Roentgen views of hemangiomata of the colon. The intramural colonic masses contain phleboliths.

interval. Fluid within the hip joint may account for an apparent disproportionate increase in muscle mass bordering the pelvis on the affected side (that is, obturator internus).

Calcifications.[2] Spherical phlebolith calcifications with their radiolucent centers rarely are, *per se*, of significant or pathologic importance. Occasionally, when present within a mass, they indicate a definitive diagnosis of hemangioma (Figure 5). Change in phlebolith position may herald an otherwise undetected pelvic mass. Amorphous calcification occurs within well circumscribed areas of uterine fibromas and in 10 per cent of ovarian fibromas. It is also deposited throughout all layers of the wall of a tuberculous bladder. Asymmetric tubular calcification is rarely observed in associated ureteral involvement. Tuberculous cystitis is noted within the mass of the contracted bladder, whereas plaque-like, thin vesical calcification and symmetric, tubular, ureteral calcification has been described in schistosomiasis hematobium. Rarely is calcification of the seminal vesical observed in tuberculosis.

Degenerative calcification of the ductus deferens is common and is located in the middle muscular layer. Seventy per cent of patients with ductus deferens calcification (Figure 6) have diabetes mellitus, whereas of all male diabetics, 11 per cent have this sign. In females the counterpart of this calcification is tubular calcification related to the fallopian tubes. Ureteral calculi are usually at the ureterovesical junction above the interspinous plane, oriented in the plane of the ureter.

Fine, punctate pelvic calcifications (psammomas) are found in approximately 12 per cent of patients with papillary cystadenoma and papillary cystadenocarcinoma. Only rarely does the metastatic lesion manifest these calcifications, and the primary pelvic lesion remains grossly normal. Plaque-like or curvalinear calcifications are observed in other soft tissue masses of the pelvis. They are not uncommon with pseudomyxoma peritonei resulting from appendiceal mucocele or ovarian mucinous tumor. Calculi of appendiceal, tubal or bladder origin may be single, multiple, laminated or faceted.

Most important in pediatric pelvic studies is vesical calcification, which is often asymptomatic. It is found half as often as renal calculi and in a ratio of nine males to one female. Ligamentous calcification, particularly of the sacrotuberous ligaments, has been observed in fluoride poisoning and it constitutes a hazard to successful labor during pregnancy.

Metal. Pathologic densities of a metallic nature result from either ingestion or purposeful introduction. The most commonly used element is that in the barium enema examination, which assists in clearly delineating normal and pathologic pelvic anatomic structures. Introduction of barium into the rectal wall forms a barium granuloma. Another density is that caused by intrauterine pessary placed long previously and otherwise concealed on vaginal inspection by the cervix. Residual contrast media may be observed within the pelvic peritoneum secondary to hysterosalpingography, particularly when a medium with an oily base has been used.

Figure 6.—Film shows ductus deferens calcification. Tubular oblique calcium deposits are above the shadow of the bladder.

Pelvic Gynecography[3]

The soft-tissues of the pelvis are particularly suited for additional examination with contrast medium. Various studies, including those of the colon, pyelography, cystography, pneumoperitoneography, angiography and, more recently, celiography, aid in clearly defining the extent and usually the nature of pelvic pathologic processes. Before these studies a preliminary plain-film examination is needed to serve as a baseline in analyzing the findings on contrast radiography.

Pelvic gynecography[3] emphasizes the current resurgence in diagnostic evaluation of roentgenograms of pelvic tissues.

Method and Complications. After colonic cleansing and micturition, preliminary plain-film studies are obtained. Approximately 1,500 ml of nitrous oxide is introduced into the peritoneal cavity of the patient, usually through an upper abdominal opening distant from solid viscus and abdominal scars. Nitrous oxide is an agent of choice because it is soluble in the blood, avoids air emboli and is relatively stable. The author has accidentally introduced nitrous oxide into the abdominal wall and retroperitoneal space without untoward reaction.

After the anesthetic has been administered and the needle removed, the patient is placed in a prone position and the foot of the table inclined to 45°. The patient is asked to assume the knee-chest position in order to displace any bowel confined to the pelvis. Otherwise, air, carbon dioxide, nitrous oxide

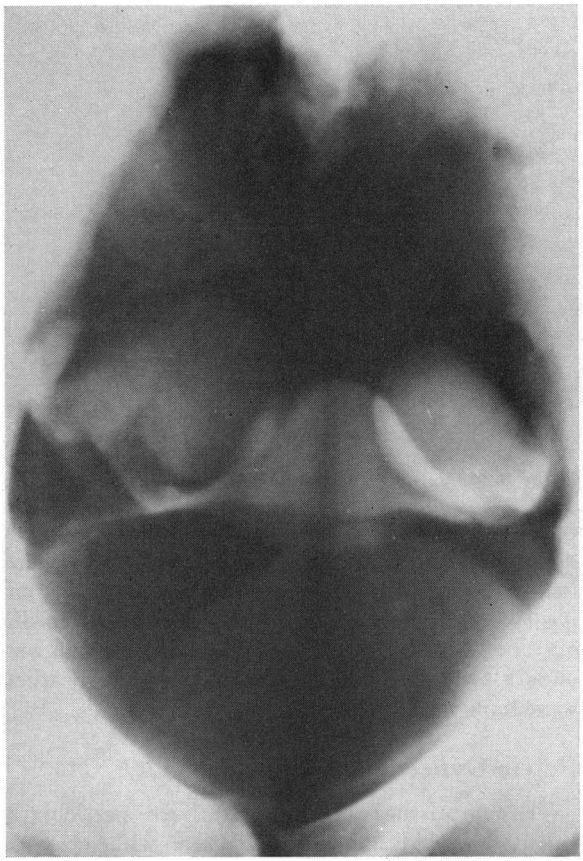

Figure 7.*—Gynecogram showing polycystic ovaries. The area of each ovary approximates that of the uterine fundus.

and/or contrast medium may be introduced into the colon in order to identify colonic structures. Usually the x-ray beam is directed perpendicularly to the floor, through the patient's pelvis, and the exposure then made. Details of the uterine ligaments and of the adnexal and pelvic wall are easily evaluated by this method. The direction of the x-ray beam and the position of the patient may be varied in the individual case.

Diaphragmatic irritation (referred as shoulder pain) or distention or bloating of the abdomen are not uncommon during and after the procedure. As most of the pneumoperitoneum is resorbed within two hours, the patient need not be kept in hospital. Local discomfort is indicative of improper placement of contrast material during examination. Subjective bloating with loss of percussive dullness over the liver, and complaint of shoulder discomfort in some cases, indicate proper placement. Hysterosalpingograms have been combined with these studies, but rarely are a necessary adjunct.

Indications for Gynecography and Interpretation of Roentgenograms. The prime value of gynecography is its clear indisputable identification of normal and pathologic states in the pelvis, especially in obese patients in whom bimanual examination is controversial and the preoperative or postoperative state unknown. In children, the confirmation of a uterine mass and adnexal structures is possible. Polycystic ovaries may indicate the Stein-Leventhal syndrome if hirsutism without virilization and menstrual irregularities (usually oligomenorrhea or amenorrhea) have been noted. Hirsutism in this syndrome is present in about half the patients and uterine hypoplasia in about three-fourths of them. The polycystic ovary approximates at least three-fourths of the uterine fundus, whereas the normal ovary seldom occupies more than half or less than one-quarter. In Figures 7 and 8 the gynecograms contrast the appearance of a normal pelvis with that of a Stein-Leventhal syndrome. Surgical procedures confirmed each.

*Figures 1, 2 and 7 appear in Noonan, C. D.: Plain-film diagnosis of acute gynecologic disorders and obstetric complications, 2:167-181, April, 1964. Courtesy, Radiologic Clinics of North America.

Figure 8.—Gynecogram of normal uterus and adnexa.

Pneumoperitoneum has been recommended for evaluation of pelvic structures since 1918, and with Stein's description of the polycystic ovary in 1935, the radiologist should be prepared to evaluate pelvic gynecograms. Adnexal or uterine masses of all kinds, as well as pelvic adhesions, become readily visible when outlined by contrast material.

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